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TECHNICAL MEMORANDUM

(TM Series)

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Utility Program Description
Milestone XI
Subroutine Timer (SRTIMER)

By

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28 March 1963

Approved By

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SUBROUTINE INDENTIFICATION

A. Title: Subroutine Timer (SRTIMER) - Ident K29, Mod. 01

B. Programmed: 20 March 1963, H. W. Houghton, System Development Corporation

C. Documented: 27 March 1963, H. W. Houghton, System Development Corporation

PURPOSE

SRTIMER is generalized routine for timing COP system programs.

USAGE

A. Calling Sequence:

L	NOP	R
	SLJ	4 SRTIMER
L + 1	Normal Return	
	ZRO	N
L + 2	A	
L + 3	B	
L + 4	C	
L + 5	P_1	
L + 6	P_2	
.	.	
.	.	
.	.	
L + 2 + N	P_{N-3}	
L + 3 + N	M_1	
.	.	
.	.	
.	.	
L + 2 + N + R	M_R	

Where R = number of modifications

N = number of parameters (including the three control parameters A, B, and C for SRTIMER)

A = number of times the program is to be timed.

= 0 for timing the program the necessary number of times for it to run 10 to 100 seconds to obtain an accurate average.

B = 0 for setting the Accumulator, Q-Register, and Index Registers as entrance parameters.

= 1 for normal function calling sequence, i.e., normal return in $\alpha + 1$ with parameters following.

= 2 for two returns (normal and error) in $\alpha + 1$ and $\alpha + 2$.

= 3 for return following calling sequence.

C = name in BCD of program to be timed.

P_1= Accumulator contents (B = 0) or first parameter of calling sequence ($B \neq 0$).

P_2= Q-Register contents (B = 0) or second parameter ($B \neq 0$).

P_3= Index designation (B = 0) or third parameter ($B \neq 0$).

P_4= Index contents (B = 0) or fourth parameter ($B \neq 0$).

If B = 0, P_5 and P_6, P_7 and P_8 may be given for a second and third index register.

P_N= Nth parameter ($B \neq 0$).

M_1= first modification ($B \neq 0$).

M_R= Rth modification ($B \neq 0$).

B. Format of Function Card

*SRTIMER A B C $P_1 \ldots P_N, M_1 \ldots M_R$

where A, B, C, $P_1 \ldots P_N$, $M_1, \ldots M_R$ are as given above.

C. Printouts:

SRTIMER will printout on-line the running time of the program being timed. The printout is as follows:

TIME FOR CCCCCCCC ROUTINE IS XXXXX SEC, YYYYYY MICROSEC.

Also, if desired, SRTIMER will printout:

COMPUTER IS ZZ.ZZ PERCENT FAST (or SLOW)

This is the speed of the computer compared with the machine specifications.

D. There are no error returns from SRTIMER.

E. Tape assignments depend on the program being timed.

F. Jump key 2 is set if the computer speed printout is desired.

METHOD

On the first entry to SRTIMER the speed of the computer is checked by doing a loop of known length. The constants used in the timing portion are adjusted to compensate for the difference of the individual computer from the 1604 specifications. Also a check is made to determine whether SRTIMER was loaded in an even or an odd location. The set of constants used is dependent on the bank in which the program starts.

For all entries to SRTIMER the type of calling sequence needed by the routine to be timed is determined and an appropriate calling sequence is set up. COP is referenced to find the starting location of the routine and this address is placed in the return jump. The Real Time Clock is set to - 2 and started. When the clock turns to zero, the return jump to the subroutine is made. After the subroutine is run, control is returned to SRTIMER. If A, i.e. the "number of times" parameter equals 0 or 1, the computer will immediately start executing a loop of known duration unitl the clock changes. When the time in the loop is subtracted from the total times, we have the time in the subroutine. If A is other than 0 or 1, the return jump to the subroutine is executed the proper number of times before the loop is started. After the routine has been timed, the total time is divided by the number of times the routine has been executed. This gives us the time for one execution of the routine. In the case that A = 0, SRTIMER checks to see if the routine took longer than ten seconds. If not, it will determine a number of times (10, 100, 1,000 or 10,000) such that at least ten seconds will elapse during the timing and executes the routine this number of times.

RESTRICTIONS

A. The accuracy is dependent on the number of times the subroutine is executed. If the subroutine is operated one time the results will be accurate within .05% or twenty microseconds, whichever is greater. The error can be reduced to .05% or 2 microseconds by executing the subroutine more times. Any routines that use I-O devices will probably produce inconsistant times due to variance in speed of the devices.

B. "A" must be equal to 1 if the routine does not housekeep itself.

C. "A" should not be equal to 0 if the routine initiates an I-O operation and does not wait for its completion.

D. Routine being timed must not use the Real Time Clock.

E. The on-line printer is used. Other components may be needed for the subroutine being timed.

F. SRTIMER uses subroutines OUTPUT, SUBERR, and FLOAT.

G. Index Registers 1, 2 and 3 are always used. The others may be used by the subroutines being timed. All of the index registers are saved and restored prior to exiting.

H. COPII must be used. SRTIMER refers to ADDROF.

I. If a series of programs are being timed and there is danger of COPII reallocating space above 10000B, a function card of the following format should be used.

   * 10000B SRTIMER . . . .

   This will reload SRTIMER at 10000B and remove the possibility of being destroyed by the reallocation of space.

TIMING

The timing is dependent on the subroutine being timed and whether or not it is in core when SRTIMER is called.

STORAGE REQUIREMENTS

Space Allocation:

Program	146
Constants	26
Printouts	12
Temporary Storage	111
TOTAL	295

VALIDATION TESTS

A break point was set to stop the computer just before the clock was started. When the computer halted the break point was reset to stop the computer after a fairly long routine (approximately 1/3 minute) had been executed. The observed time between restart and the second break point and the computed time was equal. Also, two octals were added to the deck to allow a jump to the normal return without executing any subroutine. This deck was operated over 100 times with A equal to various values. For A = 1, the results were between -20 and 20 microseconds. As A was increased the error bounds decreased until they reached $\pm$ 2 µseconds. Without the octals several subroutines were operated. When runs of a given program were repeated, the results were within .05% of the average value.

REFERENCES

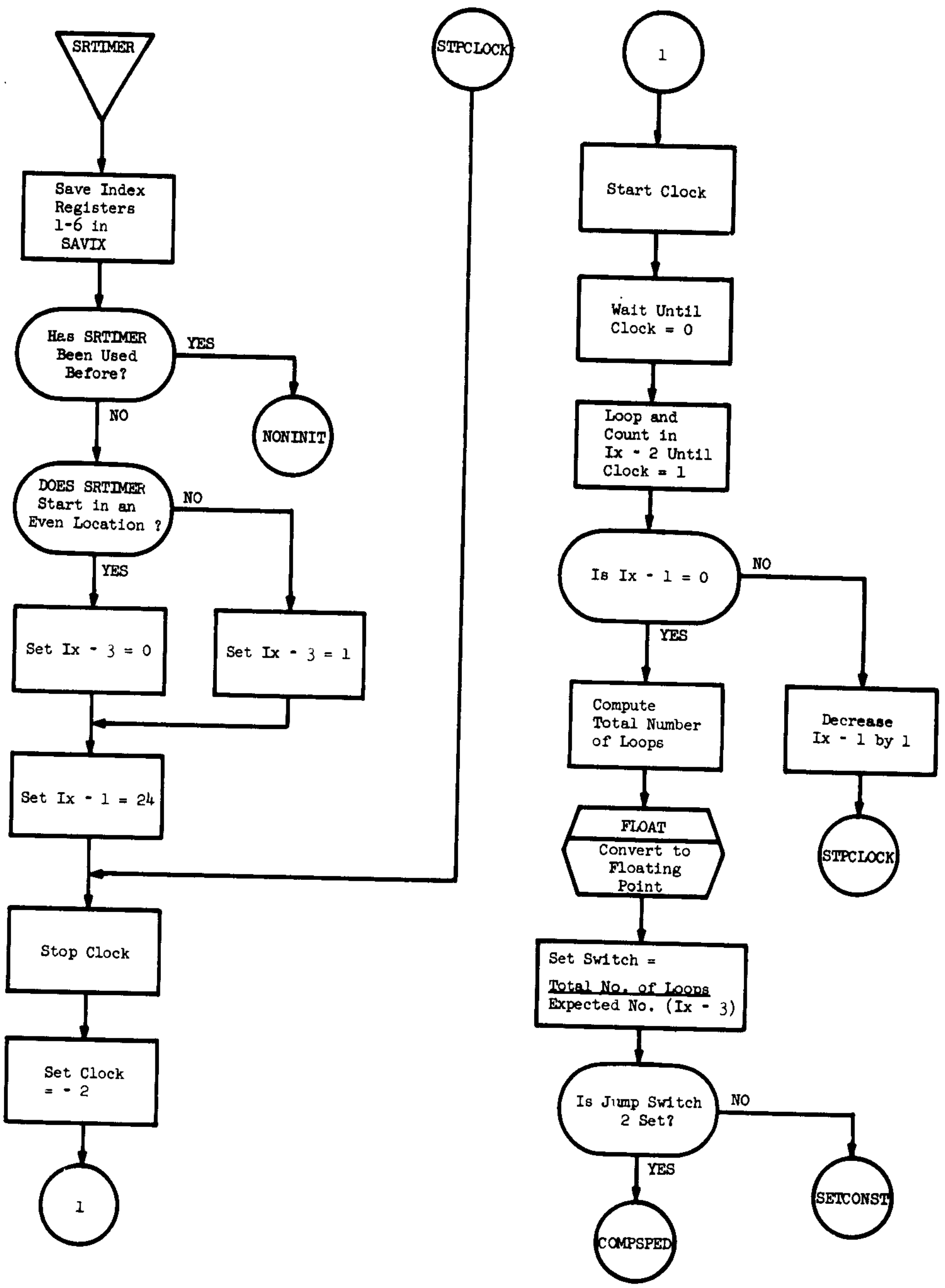
A. TM-966621/005/00 Execution Times for Instructions on the CDC 1604 Computer, 2 November 1962.

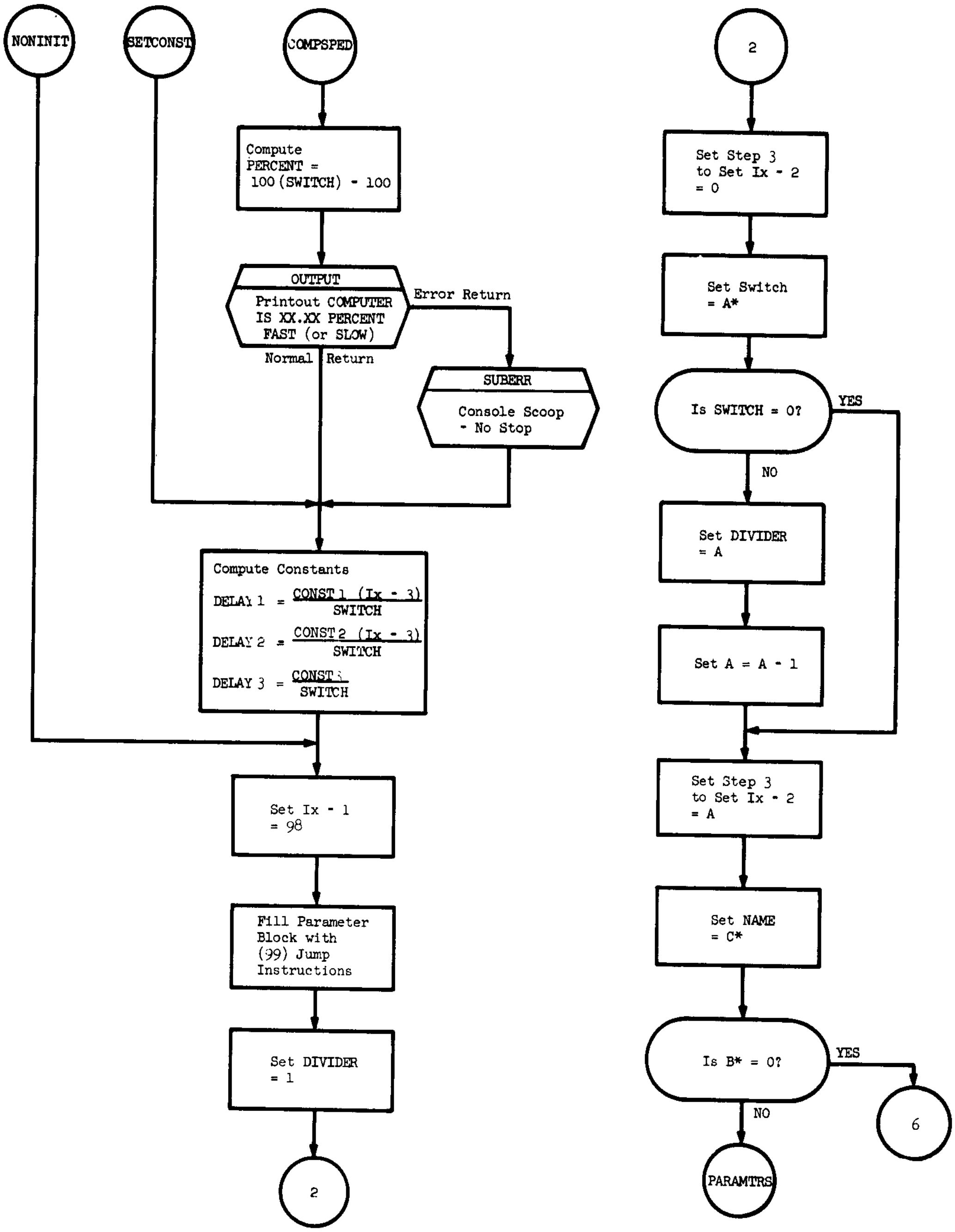
B. IMSD-447578, System Manual Subroutine Description of OUTPUT, 3 June 1960, pages 45.14.01 f.f.

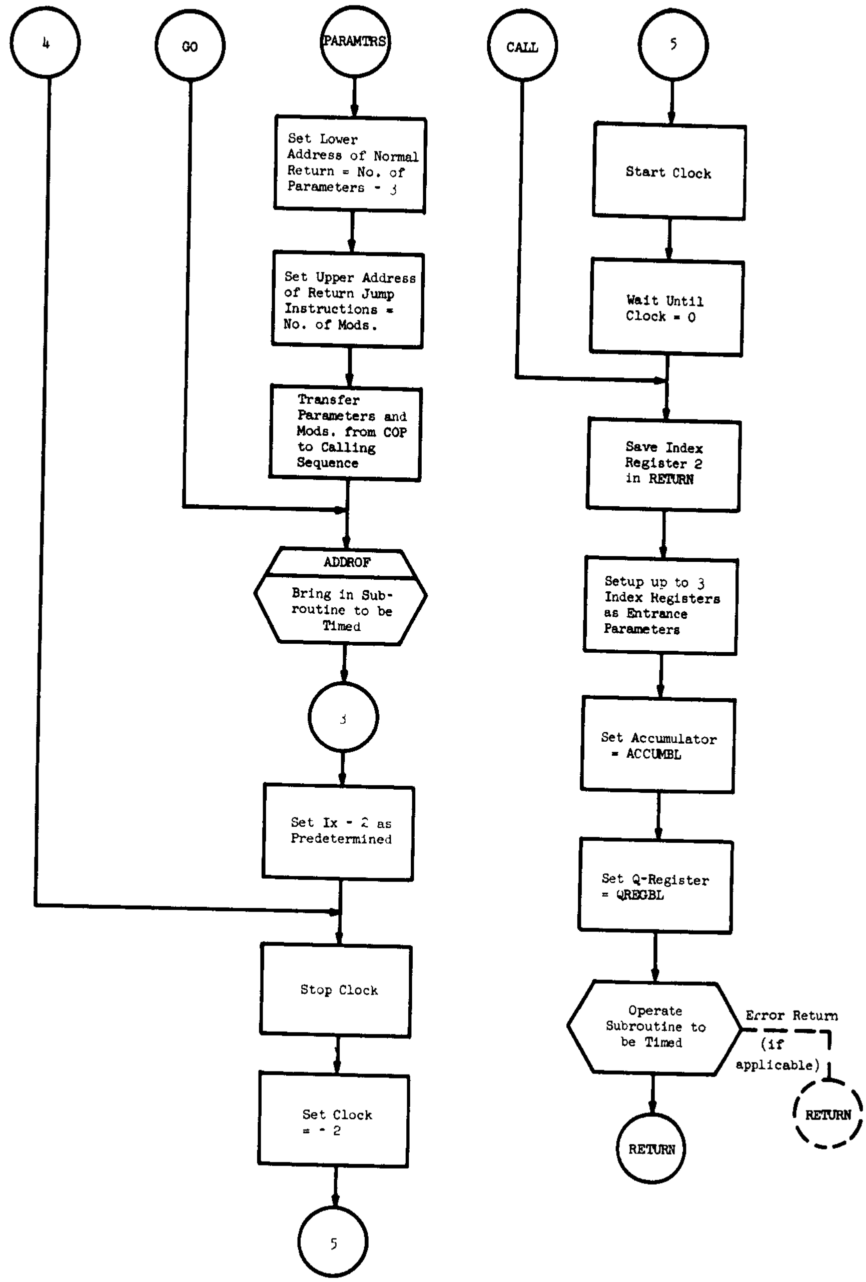
C. IMSD-44578, System Manual Subroutine Description of SUBERR, 21 July 1961, pages 50.06.01 f.f.

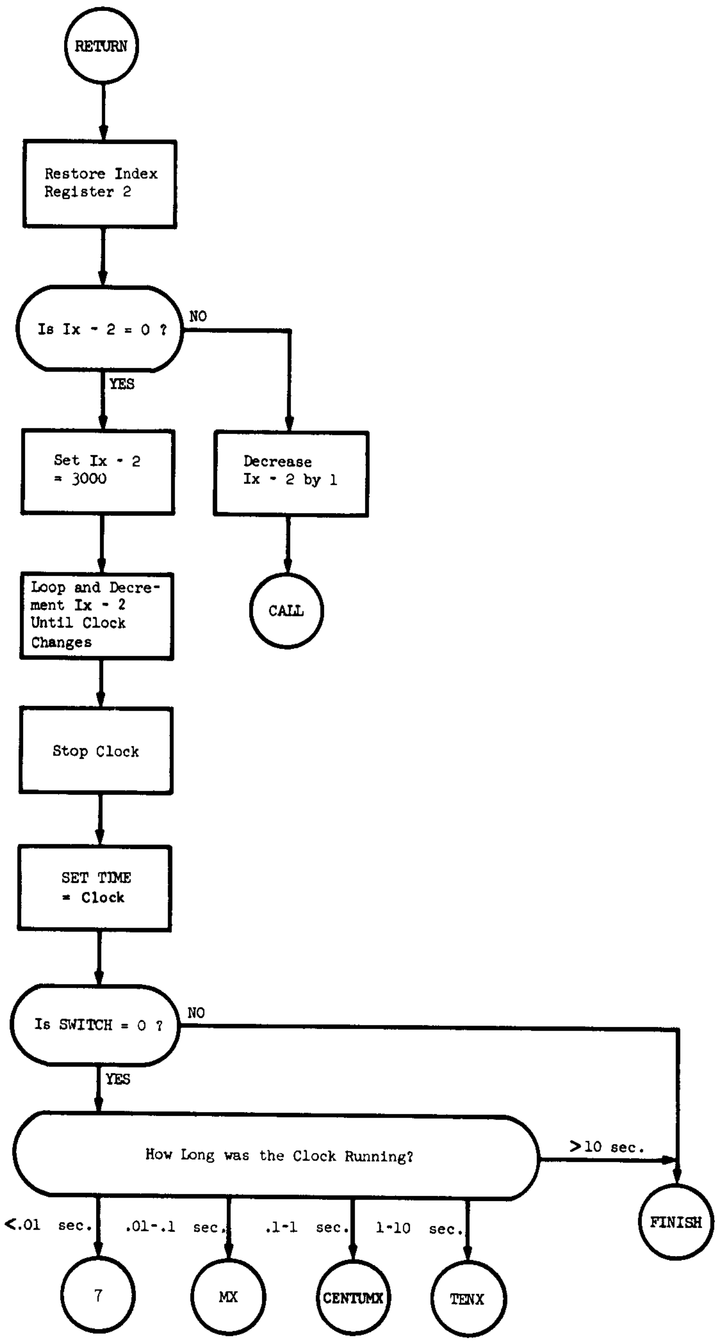
D. TM-(L)-705/014/00 SCF System Manual Subroutine Description of FLOAT, 11 September 1962.

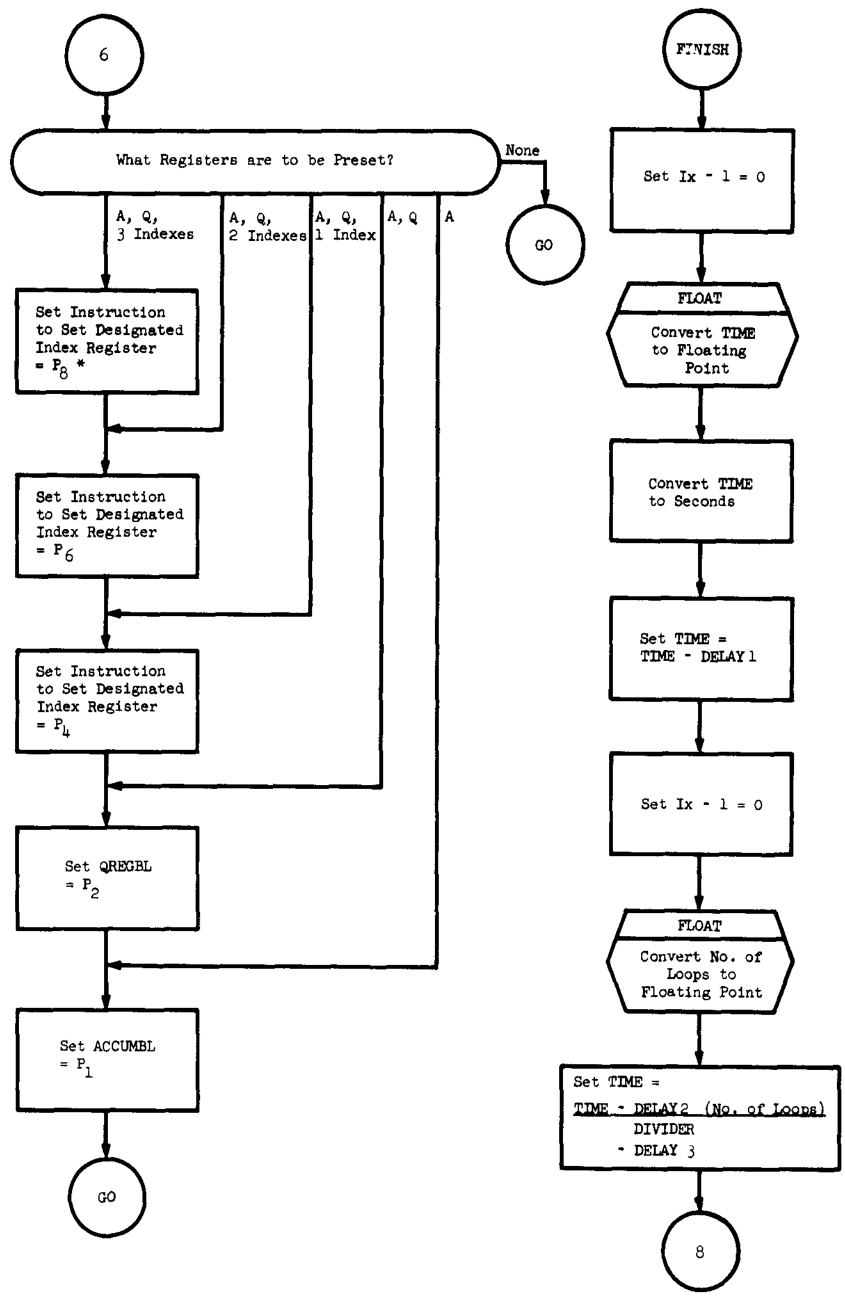
Flow Charts

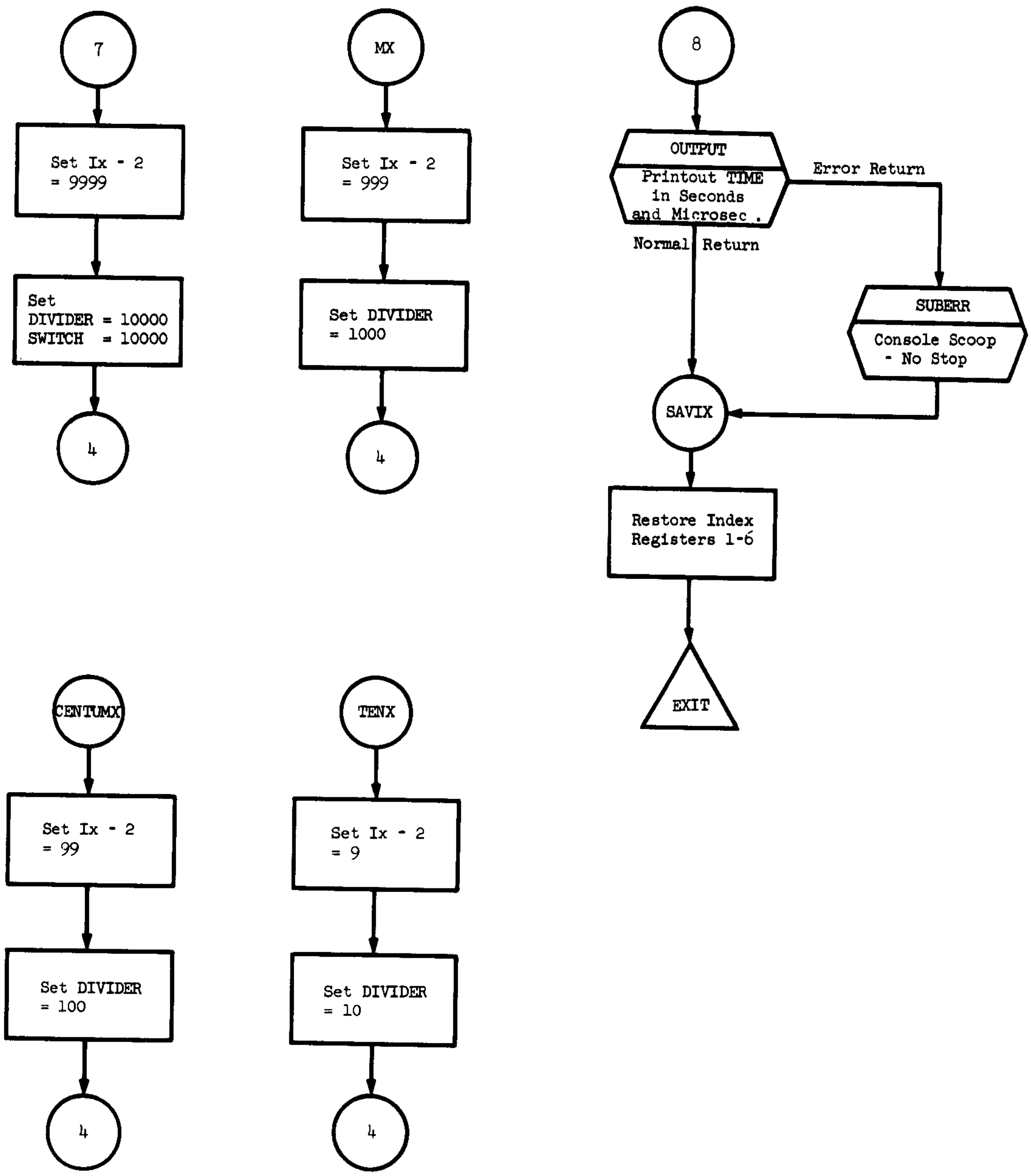

SRTIMER
Save Index Registers 1-6 in SAVIX
Has SRTIMER Been Used Before?
YES
NONINIT
NO
DOES SRTIMER Start in an Even Location ?
NO
YES
Set Ix - 3 = 0
Set Ix - 3 = 1
Set Ix - 1 = 24
STPCLOCK
Stop Clock
Set Clock = - 2
1
1
Start Clock
Wait Until Clock = 0
Loop and Count in Ix - 2 Until Clock = 1
Is Ix - 1 = 0
NO
YES
Compute Total Number of Loops
Decrease Ix - 1 by 1
STPCLOCK
FLOAT
Convert to Floating Point
Set Switch = Total No. of Loops / Expected No. (Ix - 3)
Is Jump Switch 2 Set?
NO
YES
COMPSPED
SETCONST


NONINIT
SETCONST
COMPSPED
Compute PERCENT = 100 (SWITCH) - 100
OUTPUT
Printout COMPUTER IS XX.XX PERCENT FAST (or SLOW)
Error Return
Normal Return
SUBERR
Console Scoop - No Stop
Compute Constants
DELAY 1 = CONST 1 (Ix - 3) / SWITCH
DELAY 2 = CONST 2 (Ix - 3) / SWITCH
DELAY 3 = CONST 3 / SWITCH
Set Ix - 1 = 98
Fill Parameter Block with (99) Jump Instructions
Set DIVIDER = 1
2
2
Set Step 3 to Set Ix - 2 = 0
Set Switch = A*
Is SWITCH = 0?
YES
NO
Set DIVIDER = A
Set A = A - 1
Set Step 3 to Set Ix - 2 = A
Set NAME = C*
Is B* = 0?
YES
NO
6
PARAMTRS


4
GO
PARAMTRS
CALL
5
Set Lower Address of Normal Return = No. of Parameters - 3
Set Upper Address of Return Jump Instructions = No. of Mods.
Transfer Parameters and Mods. from COP to Calling Sequence
ADDROF
Bring in Subroutine to be Timed
3
Set Ix - 2 as Predetermined
Stop Clock
Set Clock = - 2
5
Start Clock
Wait Until Clock = 0
Save Index Register 2 in RETURN
Setup up to 3 Index Registers as Entrance Parameters
Set Accumulator = ACCUMBL
Set Q-Register = QREGBL
Operate Subroutine to be Timed
Error Return (if applicable)
RETURN
RETURN


RETURN
Restore Index Register 2
Is Ix - 2 = 0 ?
NO
YES
Set Ix - 2 = 3000
Decrease Ix - 2 by 1
CALL
Loop and Decrement Ix - 2 Until Clock Changes
Stop Clock
SET TIME = Clock
Is SWITCH = 0 ?
NO
YES
How Long was the Clock Running?
>10 sec.
FINISH
<.01 sec.
.01-.1 sec.
.1-1 sec.
1-10 sec.
7
MX
CENTUMX
TENX


6
What Registers are to be Preset?
None
GO
A, Q, 3 Indexes
A, Q, 2 Indexes
A, Q, 1 Index
A, Q
A
Set Instruction to Set Designated Index Register = P8 *
Set Instruction to Set Designated Index Register = P6
Set Instruction to Set Designated Index Register = P4
Set QREGBL = P2
Set ACCUMBL = P1
GO
FINISH
Set Ix - 1 = 0
FLOAT
Convert TIME to Floating Point
Convert TIME to Seconds
Set TIME = TIME - DELAY 1
Set Ix - 1 = 0
FLOAT
Convert No. of Loops to Floating Point
Set TIME = TIME - DELAY 2 (No. of Loops) DIVIDER - DELAY 3
8


7
Set Ix - 2
= 9999
Set
DIVIDER = 10000
SWITCH = 10000
4
MX
Set Ix - 2
= 999
Set DIVIDER
= 1000
4
8
OUTPUT
Printout TIME
in Seconds
and Microsec.
Error Return
Normal Return
SUBERR
Console Scoop
- No Stop
SAVIX
Restore Index
Registers 1-6
EXIT
CENTUMX
Set Ix - 2
= 99
Set DIVIDER
= 100
4
TENX
Set Ix - 2
= 9
Set DIVIDER
= 10
4

ALLFREE, D.	24083	KEY, C. D.	23013
ALPERIN, N. I.	22153	KEYES, R. A.	24073
ARMSTRONG, E.	24123	KINKEAD, R. L.	22093
BERNARDS, R. M.	SUNNYVALE	KNEEMEYER, J. A.	22088A
BIGGAR, D.	24118A	KNIGHT, R. D.	22119
BILEK, R. W.	23007	KOLBO, L. A.	22155
BLACK, H.	14039	KOSTINER, M.	14056B
BRENTON, L. R.	24103B	KRALIAN, R. P.	14039
BURKE, B. E.	24086	KRISTENSEN, K.	SUNNYVALE
BURKE, R. F.	22158	LACHAPELLE, F.	22093
CHAMPAIGN, M. E.	22152	LAUGHLIN, J. L.	24073
CHIODINI, C. M.	24091	LAVINE, J.	24093
CIACCIA, B. G.	24082A	LITTLE, J. L.	24088B
CLINE, B. J.	24127	LONG, F.	22156
COGLEY, J. L.	22156	MADRID, G. A.	22081
CONGER, L.	24088A	MAHON, G. A.	24089
COOLEY, P. R.	24081	MARIONI, J. D.	24076B
COURT, T. D.	24086B	MARTIN, W. P.	24127B
CRUM, D. W.	24105	MCKEOWN, J.	23013
DANT, G. B.	24086B	MICHAELSON, S. A.	14039
DECUIR, L. E.	24053A	MILANESE, J. J.	22155
DERANGO, W. C.	24082B	MUNSON, J. B.	22087A
DEXTER, G. W.	25016	MYERS, G. L.	14056A
DISSE, R. J.	23014	NELSON, P. A.	24075
DOBBS, G. H.	22116B	NG, J.	22077
DOBRUSKY, W. B.	24065A	NGOU, L.	24127
ELLIS, R. C.	22131A	PADGETT, L. A.	24110A
EMIGH, G. A.	14039	PATIN, O. E.	SUNNYVALE
ERICKSEN, S. R.	22113	POLK, T. W.	24113
FELKINS, J.	24097	PRUETT, B. R.	22084
FOSTER, G. A.	14039	RAYBIN, M.	14039
FRANKS, M. A.	24122	REILLY, D. F.	24121
FREY, C. R.	22078	REMSTAD, C. L.	25026
FRIEDEN, H. J.	22082	RUSSELL, R. S.	14054
GARDNER, S. A.	25026	SCHOLZ, J. W.	14039
GREENWALD, I. D.	22094A	SCOTT, R. J.	24110
GRIFFITH, E. L.	22081	SEACAT, C. M.	SUNNYVALE
HAAKE, J. W.	22153	SEIDEN, H. R.	22126B
HARRIS, E. D.	24081	SHAPIRO, R. S.	24110B
HENLEY, D. E.	22094B	SKELTON, R. H.	22148
HILL, C. L.	22101	SOLOMON, J.	22076
HILLHOUSE, J.	22078	SPEER, N. J.	24086A
HOLMES, M. A.	24103	STONE, E. S.	24058B
HOLZMAN, H. J.	24065B	SWEENEY, M. J.	25026
HOUGHTON, W. H.	24103B	TABER, W. E.	22101
HOYT, R. L.	14039	TENNANT, T. C.	27029
IMEL, L. E.	14039	TESTERMAN, W. D.	14039
KASTAMA, P. T.	22076	THOMPSON, J. W.	24088
KAYSER, F. M.	24109	THORNTON, R. L.	14050
KEDDY, J. R.	24105	TOTSCHEK, R. A.	24120

WINSOR, M. E.	22156	VORHAUS, A. H.	24076A
WINTER, J. E.	24117	WAGNER, I. T.	24093
WISE, R. C.	22085	WARSHAWSKY, S. B.	24097
WONG, J. P.	SUNNYVALE	WEST, G. D.	SUNNYVALE
ZACHTE, S. A.	24086	WEST, G. P.	22116A
ZUBRIS, C. J.	24075	WILSON, G. D.	24124

UNCLASSIFIED

System Development Corporation,
Santa Monica, California
UTILITY PROGRAM DESCRIPTION -
MILESTONE XI SUBROUTINE TIMER(SRTIMER).
Scientific rept., TM(L)-715/037/00,
by H. W. Houghton. 28 March 1963,
11p., 4 refs.
(Contract AF 19(628)-1648, Space
Systems Division Program, for
Space Systems Division, AFSC)
Unclassified report

DESCRIPTORS: Satellite Networks.
Programming (Computers).

UNCLASSIFIED

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Reports that SRTIMER (Subroutine Timer) is a generalized routine for timing COP system programs. Also reports that on the first entry to SRTIMER the speed of the computer is checked by doing a loop of known length. States that the constants used in the timing portion are adjusted to compensate for the difference of the individual computer from the 1604 specifications. Also states that a check is made to determine whether SRTIMER was loaded in an even or an odd location.

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